

## **Appendix A – Agency Correspondence**

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**TENNESSEE HISTORICAL COMMISSION**  
DEPARTMENT OF ENVIRONMENT AND CONSERVATION  
2941 LEBANON ROAD  
NASHVILLE, TN 37243-0442  
(615) 532-1550

April 8, 2008

Dr. Thomas Maher  
Tennessee Valley Authority  
400 W. Summit Hill Drive  
WT 11D - Cultural Resources  
Knoxville, Tennessee 37902

RE: TVA, TIMS FORD/CHANGES TO DAM RELEASES, UNINCORPORATED,  
FRANKLIN COUNTY

Dear Dr. Maher:

Pursuant to your request, this office has reviewed documentation concerning the above-referenced undertaking received Tuesday, April 1, 2008. This is a requirement of Section 106 of the National Historic Preservation Act for compliance by the participating federal agency or applicant for federal assistance. Procedures for implementing Section 106 of the Act are codified at 36 CFR 800 (Federal Register, December 12, 2000, 77698-77739).

Considering available information, we find that the project as currently proposed will not adversely affect any property that is eligible for listing in the National Register of Historic Places. Therefore, this office has no objection to the implementation of this project. Please direct questions and comments to Jennifer M. Barnett (615) 741-1588, ext. 105. We appreciate your cooperation.

Sincerely,

E. Patrick McIntyre, Jr.  
Executive Director and  
State Historic Preservation Officer

EPM/jmb



Tennessee Valley Authority, 400 West Summit Hill Drive, Knoxville, Tennessee 37902-1499

March 28, 2008

Mr. Patrick McIntyre  
Deputy State Historic Preservation Officer  
Tennessee Historical Commission  
2941 Lebanon Pike  
Nashville, Tennessee 37243-0442

Dear Mr. McIntyre:

**TVA, PROPOSED MODIFICATIONS TO DAM RELEASES AT TIMS FORD, FRANKLIN COUNTY, TENNESSEE**

The Tennessee Valley Authority (TVA) proposes to modify releases at Tims Ford Hydroelectric Plant and Dam in order to improve habitat conditions for federally-listed endangered and candidate aquatic species in the Elk River. This proposed change was a result of long-term consultation with the U.S. Fish and Wildlife Service (USFWS) regarding TVA's reservoir operations (Reservoir Operations Study 2006). Improved habitats are intended to provide protection and recovery of the endangered boulder darter and cracking pearl mussel, as well as the protected shiny pigtoe, birdwing pearl mussel, Cumberland monkeyface pearl mussel, slabside pearl mussel, sheepsnose, and fine-rayed pigtoe.

In order to improve conditions on the Elk River, TVA has proposed to increase water temperatures and mimic natural flow regimes. Effects of these changes will be monitored to manage success rates and may be modified if improvements are not found.

TVA proposes the following:

- TVA will determine allowable releases from Tims Ford Dam by monitoring temperature at ERM 119.3 (downstream of the confluence with Beans Creek). A predictive hydrothermal model (similar to those employed to ensure thermal compliance at TVA power plants) would be developed to plan releases on a weekly basis.
- TVA will spill essentially 100% of flows from May 1 - October 15. No use of the large turbine will be allowed during this period (unless required because of a potentially damaging flood event). Some use of the sluice may be required to make sure that temperatures in the 'trout zone' (Tims Ford Dam to Beans Creek/Old Dam Ford) are not too warm. Currently the trout fishermen abandon the Old Dam Ford access some time in July due to higher water temperatures and move to upstream access points.

Mr. Patrick McIntyre  
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- During this period, TVA will increase allowable minimum flow at the dam to 200 - 300 cfs in order to move water through the system, since the turbine will not be in use. A minimum flow of 80 cfs will continue to be implemented during low inflow conditions. Minimum flows will be provided by spill and limited use of the sluice. (The exact value for this is not yet set and will depend primarily upon effects on the ability of fishermen to access the river. Setting this higher minimum flow will be part of the adaptive framework).
- Beginning the first week in November, TVA can begin release of water through the large turbine, not to exceed 25% of weekly average flow. During the second week in November, TVA can increase use of generator to 50% of weekly average flow. Week three (3) generator use can equal 75% of weekly average flow. Week four (4), TVA can use the large turbine for 100% of weekly average flow. This will provide a gradual acclimation period to colder winter temperatures in the tailwater.
- 'Flood' flows resulting from heavy rainfall events that occur May 1 - October 15) will be dispatched primarily by spilling, rather than through the turbine. In the case of extremely large, potentially damaging flood events (provided temperature criteria are met at ERM 119.3) some limited use of the large turbine may be allowed at these times.
- Tims Ford Dam will be operated in a 'typical' manner from December 1 - April 31. "Peaking" generation would be allowed during this time period.
- TVA, Tennessee Wildlife Resource Agency, and USFWS would monitor the effects of these changes to evaluate whether or not the changes improve habitat conditions upstream of Fayetteville to the point that boulder darter and listed fish could be re-introduced into this section of the river. If the planned changes do not provide sufficient benefit to these species, additional changes in dam operations may be required.

Currently, Tims Ford Dam is operated for peaking power generation that can accelerate erosional processes. A few scattered segments of stream bank that exhibit significant erosion can be observed (see enclosed photos). Most of these are on the inside of bends where there is little or no buffer between agricultural fields and the river. In most cases, the erosion on the outside of bends is limited by bedrock or boulders. The effects of dam operation for peaking are evident through the upper part of the tailwater. The vegetation on the lower part of the bank is stunted or absent, and there is a tendency toward erosion and undercutting of the bank.

The proposed project will result in no power generation between the months of May and October. This lack of daily pulses is anticipated to encourage the reestablishment of vegetation along the lower parts of the banks where erosion is most evident. Vegetation is anticipated to help stabilize those banks that are currently subject to erosion.

TVA proposes the area of potential effects (APE) to be the affected shorelines below the dam extending to the town of Fayetteville, Tennessee. While no systematic archaeological survey has been conducted in this area, several archaeological sites

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have been recorded along the banks of the Elk River (see enclosed map). While the status of these sites is unknown, TVA finds that the proposed action would have a beneficial impact to these, as well as other unknown resources located in below Tims Ford Dam. This finding is based on the anticipated reduced erosional impacts as a result of the reduction in operational pulsing from dam generation and the potential for increased vegetation growth that will naturally stabilize the existing shoreline. In addition, TVA finds that the proposed action does not have the potential to effect historic structures.

Pursuant to Section 106 of the *National Historic Preservation Act* and its implementing regulations at 36 CFR § 800.4, TVA has determined that the project, as currently proposed, would not affect any historic properties. TVA is seeking your office's concurrence on our findings and recommendations.

TVA is consulting with the following federally recognized Indian tribes regarding properties within the proposed project's APE that may be of religious and cultural significance to them and eligible for the National Register of Historical Places: Cherokee Nation, Eastern Band of the Cherokee Indians, United Keetoowah Band, The Chickasaw Nation, Choctaw Nation of Oklahoma, Jena Band of Choctaw Indians, Muscogee (Creek) Nation of Oklahoma, Alabama-Coushatta Tribe of Texas, Alabama-Quassarte Tribal Town, Kialegee Tribal Town, Thlopthlocco Tribal Town, Absentee Shawnee Tribe of Oklahoma, Eastern Shawnee Tribe of Oklahoma, and Shawnee Tribe.

If you have any questions or need further information, please contact Erin Pritchard at (865) 632-2463 or by email at [eepritchard@tva.gov](mailto:eepritchard@tva.gov).

Sincerely,



Thomas O. Maher, Ph.D.  
Manager  
Cultural Resources

EEP:IKS

Enclosures

cc: Jennifer Barnett (w/ enclosures)  
Tennessee Division of Archaeology  
Cole Building #3  
1216 Foster Avenue  
Nashville, Tennessee 37210

John T. Baxter, WT 11C-K  
Tina M. Tomaszewski, LB 5U-C  
EDMS WT 11D-K

## **Appendix B - Comments Received on Draft Environmental Assessment**

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**Tims Ford Comments**

## **AGENCY COMMENTS**

### **TWRA Comments:**

**Comment: 1.** It states that the multi-use alternative would greatly benefit the endangered boulder darter, but it does not adequately address the temperatures and flow conditions that would benefit the cracking pearly mussel and allow other mussels to recover in the upper reaches of the river (where the best mussel habitat occurred based on previous surveys). Apparently, conditions are currently being met for the continued existence of boulder darters since they must be actively recruiting in order to maintain the population. The Cumberlandian mussel fauna has been nearly extirpated from the Elk and is comprised of many species listed on the federal register. Previous sampling of the river in 1980 reported the following federal endangered mussel species: Shiny Pigtoe (*Fusconaia cor*), Finerayed Pigtoe (*F. cuneolus*), Birdwinged Pearlymussel (*Lemiox rimosus*), and Cumberlandian monkeyface (*Quadrula intermedia*) (all Cumberlandian), and Crackling Pearlymussel (*Hemistena lata*) (Ohioan faunal group) as existing in the river.

**TVA Response:** The EA has been revised to more clearly state the anticipated benefits to the mussel species in both the reach of river downstream of Fayetteville and in the reach upstream of Fayetteville. The proposed operational changes are intended to benefit fish and mussel species in the Elk River. It is anticipated that existing populations of all the listed species would benefit, and additional areas upstream of Fayetteville would become suitable for the survival and reproduction of these mussel species. Boulder darters are present in the vicinity of Fayetteville and downstream in the Elk River to ERM 30 or 31. Conditions for boulder darter survival and reproduction are probably only minimally met under the current operations. It is anticipated that the proposed operational changes would increase existing populations, and additional areas upstream of Fayetteville would become suitable for boulder darter survival and reproduction. As stated in the EA, the listed mussels are longer-lived than the boulder darter. The individuals present in the river may have been surviving without much successful reproduction. It is anticipated that the water quality and habitat improvements would produce conditions more appropriate for reproduction and also result in improvements to the warm-water fish community, including those that may act as fish hosts for listed mussels.

**Comment: 2.** The discharge of peaking flows downstream from Tim's Ford Dam would have a severe affect on substrate integrity, which is destabilized and blown off to the side affecting many minnow and darter species that rely on this habitat, and serve as mussel host fish, on the main shoals and/or riffles. Very little benefit would be realized from operating the river in a natural flow regime during May to October only to revert to peaking generation during November to April and wipe out any mussel production gained during the summer. If TVA were to operate TFH for flood control and water supply and not produce electricity or manage the best mussel habitat as a trout fishery, this would be a major step towards natural resource restoration and stewardship. A prime example of excellent Reservoir Release Improvements is Normandy Dam on the Duck River; it produces no electricity but is managed for flood control and water supply. The fish fauna is intact in the Duck River and mussel species have increased four-fold since RRI.

**TVA Response:** TFH is a multi-purpose project, intended to provide water supply, recreation, flood control, and power generation. TVA desires to make changes in TFH operations in a manner that benefits endangered species but still allows the other purposes of the TFH project to be achieved. If the current proposed changes do not result in the anticipated improvements in habitat conditions and fish and mussel populations, additional changes or other mitigative measures could be proposed to correct identified problems. The current proposed changes do not preclude the future option of curtailing power generation at Tims Ford Dam.

**Comment: 3.** Most of the Cumberlandian endemic mussel fauna along with other mussel species documented from the Elk (pre-and post construction and operation of Tim's Ford Dam and hydroelectric plant - TFH) occurred largely upstream from Fayetteville where TFH operation has extirpated much of this fauna. This reach represents the best habitat remaining in the Elk for these species as long as thermal and hydrologic characteristics are restored.

**TVA Response:** TVA agrees that the reach between Tims Ford Dam and Fayetteville represents the best available habitat in the Elk for these mussel species. The intent of this adaptive management plan is to improve this reach while meeting the other stated objectives of Tims Ford: water supply, recreation, flood control, and power generation.

**Comment: 4.** Fish and benthic IBI sampling only gives a health rating for those faunal groups. The success of mussel species restoration is based upon active recruitment of juveniles with multiple size-classes (not likely in the coldwater reach).

**TVA Response:** The EA has been revised to include a more direct measure of mussel survival and recruitment. The goal of Management Objective 4, Section 2.2.2 is to "successfully reintroduce the boulder darter and mussel species in areas upstream of their present geographic range in the Elk River." The Measure of Success is "Survival and reproduction of boulder darter and listed mussel species is observed in this reach." The river reach indicated by this objective is the area between Tims Ford Dam and Fayetteville.

**Comment: 5.** The mussel and fish fauna in the Elk River could be recovered via translocations, culture, and propagation only if Tim's Ford Dam tailwater is managed for flood control and water supply (not hydropower), with oxygenated established minimum flows that provide more natural thermal and flow conditions. This is the best alternative as the Elk offers the only hope for wide-scale preservation for many mussel and fish species since so many other streams and tailwaters are not conducive for aquatic restoration.

**TVA Response:** TVA's current preference is to determine an optimum release schedule that allows generation while also preserving fish and mussel species. However, if this does not result in the desired habitat conditions and the objectives of this action, TVA would, as part of the adaptive management plan, consider additional alternatives and other mitigative measures.

**Comment: 6.** Ahlstedt (1983) was cited in text but omitted from Literature Cited. Ahlstedt, S. A. 1983. The molluscan fauna of the Elk River in Tennessee and Alabama. American Malacological Bulletin, 1(1983):43-50.

**TVA Response:** This has been corrected in the EA.

**Comment: 7.** The biological response in Management Objectives 1 and 2 (Section 2.2.2) are essentially the same for both the reaches of river. There is no difference between “survival and successful reproduction” and “reproduction, survival and growth” because growth would be essential in both areas if reproduction is to be achieved. Could this be a typo in Objective 1 that should read “survival and successful introduction”?

**TVA Response:** Management Objective 1 intends to improve conditions that will allow for successful reintroduction of the mussels and boulder darter in the river reach where these listed species do not presently occur. The goal of Management Objective 4 is to reintroduce the boulder darter and listed mussels in the reach where the listed species do not presently occur, when the goals of Management Objective 1 have been met. Management Objective 2 by contrast, intends to improve conditions where mussels and boulder darters already occur such that their populations in those river reaches become more robust and stable.

**Comment: 8.** TWRA is concerned that the multi-use alternative will affect the chemical and temperature profile of the Tims Ford Reservoir. If spilling depletes the supply of cool, oxygenated water located at or just below the thermocline, then that could result in mortality of coolwater species such as walleye, striped bass, and hybrid striped bass. The EA presents CE-QUAL-W2 model results for the reservoir response to spilling 100% of discharge in June and July, and demonstrate that there would be no effect in those months. Our experience has been that DO limitations are most common in late summer (August-September). Please demonstrate that models support a “no effect” reservoir profile in August and September.

**TVA Response:** Reservoir Profile simulations for August and September have been added to the EA.

**Comment: 9.** Add to monitoring: Additional or more frequent chemical profiles on the reservoir to determine if the “no effect” statements about reservoir water quality hold true, given the unknown extent of the withdrawal zone.

**TVA Response:** Temperature and dissolved oxygen profiles at different depths in the Tims Ford Reservoir have been added to the monitoring plan in Appendix C.

**Comment: 10.** The EA did not provide sufficient information to evaluate the effects on the trout fishery.

a. The EA shows a series of graphs help us see what the expected temperature will be at various mile markers downstream of the dam. Based on the 100% spill models it appears that year-round trout habitat will be limited to a zone from the dam (ERM 133) downstream to some point upstream of ERM 128. The EA provides no temperature data for release discharge (ERM 133), so it is not possible to determine how much that habitat upstream of ERM 128 could support trout.

**TVA Response:** The dam discharge temperature data was added to Figure 3-3. Current plans do not include use of the 100 percent spill model as it would not meet the objective to provide suitable temperatures for the trout fishery. The Final EA has been revised.

b. A reference (page 22) to Figure 3-2 (Figure 3-3 in FEA) implies that water temperatures at ERM124 stayed below 20 °C during normal operation in 2007. When in actuality they remained below 20 °C due to 100% sluicing that took place during this time. This graph misrepresents the worst case scenario for the 2007 water temperatures. If the Spill + Sluice option was used under this situation then the water temperatures would have exceeded the 20 °C at ERM124.

**TVA Response:** The Final EA has been revised to more clearly explain that under drought conditions, sluicing the minimum flow would be done as it was done in 2007.

c. On pages 23-24 it suggests that with sluicing 80- 200 cfs and spilling that a trout fishery would extend down to ERM 119. However, in the model for ERM 128 water temperatures will exceed the 20°C trout stream designation limit from mid-July through September in the 2001 scenario, and exceeds the 20 °C trout stream designation limit in May and September in the 2004 scenario.

**TVA Response:** Limited use of the large hydroturbine has been added to operating plans to help maintain temperatures below 20°C in the trout reach.

**Comment: 11.** This plan suggests supporting a year-round trout fishery from the dam downstream to ERM 119 and then managing two contiguous sections from ERM 119 to Wheeler for warmwater species. We do not think it is realistic to suggest that we can maintain a trout fishery at ERM 119 and see improvements to a warmwater fauna at ERM 118, a mile downstream. We suggest that a transitional zone be established between the trout zone (if a trout zone can even exist, see below) and the start of the warmwater fauna zone and do not have measured objectives for the transition zone. Also, eliminating surveys in the transition zones should improve precision of the measured responses. [Similar comments: Dane Honhart]

**TVA Response:** As discussed in Section 3.1, where the transition zone occurs would be dependent upon releases, operation of the large hydroturbine, and water supply. Based on 2007 operating experience, the transition zone would most likely begin near ERM 124 during severe drought conditions, but could move farther downstream in years with more abundant water supply. For the purposes of evaluating effectiveness of the Adaptive Management Plan for 2008, the criteria would not be applied to the transition zone.

**Comment: 12.** This plan needs more specific measures of success for Management Objective 5 (i.e. maintain a year-round trout fishery below Tims Ford Dam) and it does not use proper temperature limits for trout. On page 9 it states that “use of the sluice may be required to make sure that temperatures in the TWRA trout Tailwater (Tims Ford Dam to Beans Creek/ Old Dam Ford at ERM119) are not too warm.” That is the only mention of a target for trout with respect to temperature. Then on page 44 it states that temperatures less than 24 °C are “within a range appropriate for trout survival and growth”. Trout can survive brief durations at temperatures above 20°C, but they do not grow at these temperatures and they will die if the experience is prolonged. TWRA recommends a threshold of less than 20°C. We suggest that management Objective 5 be modified in the following manner:

a. Define a reach of river that can be managed for year-round trout, while first maximizing benefit to downstream species. The distance of the trout reach should be estimated as the

dam downstream to the point at which temperatures less than 20 °C can be maintained using additional sluice to lower the temperature if needed – while considering the warmwater targets downstream. This exercise will determine if a trout zone is even possible. The 20 °C limit on the downstream end is using the assumption that the temperature at the dam will be much cooler ~ 16 °C. If the entire trout zone, from dam to end point is hovering around 19 °C then a successful year-round trout fishery should not be expected, nor promoted as part of the multi-use project.

b. At the downstream end of the estimated year-round trout zone place a temperature probe. Add a measure of success to Management Objective 5 that will require temperature to remain below 20 °C at this location.

c. The mentioned measures of success for Management Objective 5 are not specific enough, and TWRA has reliable methods to measure this objective. TVA could TWRA's survey design for electrofishing on the tailwater to assess trout populations. These 1-day/year surveys can estimate the relative abundance of trout of various sizes. This survey is normally conducted in February to monitor trout present in the tailwater prior to that year's stocking. We have about 10 years of data available. As a result of flow alterations or new public demands, future stocking rates or schedules may need to be altered, making some comparisons difficult. But even if stocking routines were altered (e.g., winter only), we could still use these data to track the relative abundance of trout over 14 inches, since we typically stock fish that are around 9-11 inches. Tracking the number of fish over 14 inches allows us to ignore recently stocked fish. Trout over 14 inches generally represent fish that survived the previous stocking and are considered to be of higher quality to anglers. We would recommend the metric be the average number of trout per hour > 14 inches based on TWRA's standard stocking sites. These surveys should be included in TVA monitoring commitments.

**TVA Response:** Maintaining any sizeable portion of the tailwater at approximately 16°C could reduce the gains for the warm-water species upstream of Fayetteville. TVA believes the trout fishery could be maintained while achieving the primary objective of improving threatened and endangered species habitat. Monitoring temperatures would help determine the reach downstream of the dam for year-round trout. Further, TVA believes the trout fishery habitat would be improved because of more stable flows and temperatures in comparison with the previous operations at Tims Ford Dam.

**Comment: 13.** TWRA requests additional management objectives targeting a reduction in sedimentation from tributaries. Improving the water temperatures may not be enough to improve populations of these endangered species. If the proper water temperatures are attained, sedimentation or other pollutants could still limit successful reproduction of existing populations and introduced populations of darters and mussels.

**TVA Response:** Watershed efforts are being addressed as part of the overall watershed team initiatives in the area. As indicated in the USFWS Biological Opinion, TVA Staff will implement Elk River tributary watershed initiative projects as opportunities arise.

**Comment: 14.** Aquatic Species Habitat Improvement Objectives (page 8) should include a survey of target species (darters and mussels) this year to determine the baseline abundance at several sites that represent suitable physical habitat for each species.

**TVA Response:** 2008 surveys are planned to identify areas in the upstream reach that are otherwise suitable habitat for mussel and fish introductions (not considering the temperature and flow issues). IBI sampling would occur at the sites identified in the current study plan.

**Comment: 15.** In section 3.5, under environmental consequences to recreation, it states that recreational activity would be the same or increase. We do not think that these assumptions should be made without onsite evaluations. Yes, there will be more days available to float the river, but most anglers wade fish the river. Consistent flows will not increase recreation if those flows are consistently too high or unsafe for users. The new flow range (80-1500 cfs) will inhibit angler's ability to wade in the river at much of that scale. According to Figure 3-4 (Figure 3-2 in FEA), there would be relatively few safe wading days. It may be appropriate to show a group of anglers what 300-1000 cfs will look like and determine a maximum safe discharge for wade fishing. Then compare the number of fishable hours during typical hydropower operations (3800 cfs or 80 cfs) to the number of fishable hours during the proposed modeled spill (continuous flow 80 to 1500 cfs) (Figure 3-4). We would predict that the new flow regime would increase boat/canoe use, but a far greater number of anglers that typically wade the river will not be able to fish.

**TVA Response:** Comment noted. Section 3.5 has been revised to include potential wade-fishing days and boating recreation days in Table 3-14.

**Comment: 16.** In the same section (3.5) there is a statement that says that suggests [sic] that fishing guides will transition from trout trips to guided trips for native species (perhaps smallmouth). This is questionable because fisheries cannot be readily substituted. In other words, just because a guide can make a living fishing for trout that does not mean that he has a similar market for bass angling.

**TVA Response:** The Final EA has been revised. Opportunities for existing trout fishing outfitters to add services to support warm water game fish angling below the trout reach can reasonably be anticipated. A number of fishing guides in Tennessee provide fishing guide service for trout, smallmouth bass, and other game fish. The list is available online at [www.tnoutdoorsmen.com/guides.htm](http://www.tnoutdoorsmen.com/guides.htm). Whether these businesses will choose to expand their services to take advantage of these opportunities, or whether new businesses will be established remains to be seen.

**Comment: 17.** Also in section 3.5 it says that TWRA may eventually choose to stock other game species. This is not practical. Due to extremely high costs to produce large (>6 inch) warmwater species such as bass, TWRA would be limited to stocking fingerling (2-4 inch) fish. If the river lacks sufficient habitat to support the native species, then we would expect extremely poor survival of warmwater species stocked as fingerlings. If the habitat is acceptable to warmwater species, then they will likely migrate into this section over time naturally. If TWRA did decide to stock game fish (say to jump start the migration into new habitat), then we would need financial support from TVA or the USFWS to do so, as our hatcheries are at capacity.

**TVA Response:** Since stocking of warm-water game species is not practical, this statement has been removed from the EA.

**Comment: 18.** TDEC's use categories list the Elk River as "Trout Stream" downstream to Fayetteville. As the EA repeatedly mentions, the summer temperatures exceed 20°C in much of this reach. This designation is a remnant from a time when TWRA stocked the lower river at least seasonally. And was likely left in place because stocking in the winter was still a possible management option. TWRA would support a recommendation to change the designation in the lower reaches of the river (to be defined) to meet the needs of the multi-use alternative.

**TVA Response:** Comment noted.

### **USFWS Comments:**

**Comment: 1.** Chapter 1. Include a short discussion on the area that could be affected by the proposed action (i.e., the area of influence). Basically, discuss the area illustrated in Figure 1-1, and how this action could have positive effects not only down to Fayetteville, but in the lower Elk River in Alabama.

**TVA Response:** A brief discussion has been added to the EA.

**Comment: 2.** Under section 2.2.2 (Management Objective 5), clearly identify which sections of the river are being managed as a rainbow and brown trout fishery.

**TVA Response:** The EA has been revised to address this comment. TDEC has listed "trout stream" as a designation of the Elk River from Tims Ford Dam downstream to Fayetteville. This area supports trout during the cooler fall and winter months. However, during summer months, water temperatures in areas between Fayetteville and Beans Creek increase above the temperatures that trout prefer (Bettoli, 2001). Water temperature conditions suitable for trout survival and growth in the Elk River are typically restricted to areas upstream of Old Dam Ford beginning in July. TWRA identifies only the area from Old Dam Ford upstream to Tims Ford Dam as a trout tailwater in its Stocked Trout Program.

**Comment: 3.** Table 2-1. It is not clear why "Habitat Improvement Objectives" would not be met during the month of June. Is this strictly based upon temperature goals?

**TVA Response:** Table 2-1 illustrates predicted water temperatures at ERM 119.3 with the 100 percent spill and sluice option. The minimum acceptable temperature for boulder darters for the month of June is believed to be approximately 21°C. As can be seen in Figure 3-5, the 100 percent spill and sluice option would be expected to produce water temperatures below 21°C during a year similar to 2004 at that locality, because the spillway pulls water from 35–40 feet below the reservoir surface. While this water is warmer than turbine discharge, it is not as warm as the water near the surface of the reservoir.

**Comment: 4.** Under section 3.2.1, we suggest elaborating more on potential habitat enhancements downstream of Fayetteville (e.g., into Alabama). Since the proposed action will likely enhance habitat well into Alabama, you might consider adding some of the more recent fish and mussel surveys. For example, GSA's 2005 Fish Community Survey at ERM 1-23 (Shepard, et al. 2005), as well as mussel surveys conducted by ADCNR, TVA, and

FWS in 2007 (Johnson unpublished data). These would likely serve as additional fixed monitoring stations for tracking trends.

**TVA Response:** The EA has been revised to address this comment.

**TDEC Comments:**

**Comment: 1.** TDEC has not adopted a position on this.

**TVA Response:** Comment noted.

**Comment: 2.** My thinking is that operational changes that benefit native species, particularly threatened and endangered aquatic species, are consistent with the purposes of the CWA and the TNWQCA. The trade-off, perhaps, is a reach of tailwater that might not be as supportive of non-native fish species, trout, stocked regularly to support recreational uses.

**TVA Response:** Comment noted.



## Public Comments:

**Comment:** How will the agencies involved monitor the temperature of the Elk at various locations? (David Perry)

**TVA Response:** A continuous ("continuous" has been defined as once every 15 to 30 minutes at other TVA locations) real time temperature monitoring and transmitting device is planned at a yet undetermined location below Tims Ford Dam. In the interim, weekly temperature measurements will be made to determine how changes are affecting water temperatures. Many of the other temperature monitors (Figure C-1) would record and be downloaded from every one to 3 months depending on season and need (See Appendix C - Monitoring Plan).

**Comment:** How *often* will the agencies involved monitor the temperature of the Elk at various locations? (David Perry)

**TVA Response:** The monitoring will vary from weekly grab measurements, continuous, real time temperature monitoring, to various other intervals for downloading recording instruments elsewhere on the river.

**Comment:** How could warming of the Elk River benefit the current trout population (specifically two - ten miles below the dam? (David Perry) [Similar comments: Tim Page, Brent Moseng, Chad Hayes, Rachel Hillis, Ralph Shuey, C.J. Sabia]

**TVA Response:** The benefits to the trout population would come from stabilized flows and temperature regimes. In the past temperatures could vary by 10 to 15 degrees C (18 to 27 degrees F) within a matter of minutes when the large hydroturbine was turned on. These temperature swings which could cause thermal shocks to the trout and other fish are illustrated by the red lines in Figures 3-5, 3-6, 3-7 on pages 28, 30, and 31 of the Final EA. Additionally, at times the temperatures in the releases are too low for even trout to enjoy optimal growth.

**Comment:** What data has been collected to show the economic impact to the local economy around Tims Ford Dam? (David Perry) [Similar comments: Ken Womack, Tim Pate, Dane Honhart, Tim Page, Dennis Sigman]

**TVA Response:** The trout fishing in the Tims Ford tailwaters is valued as a resource by TVA and by users. A 2003 study (Williams, Bettoli, 2003) found that about 84 percent of the trout anglers at this site were from 22 Tennessee counties, with 48 percent from the three counties surrounding the site (Franklin, Lincoln, and Moore). This indicates the importance to nearby residents of the trout fishing opportunities. This study estimated that visitors spent an average of \$54.45 per trip, with nonresident visitors spending an average of \$158.43. The total economic value of the trout fishing opportunities in these tailwaters over the 26-week fishing season was estimated to be \$182,852. While this value is well below that estimated for other Tennessee locations, this opportunity clearly is especially important to residents of nearby counties. In recognition of the importance of this resource, Habitat Improvement Objective Number 5 in this EA is to maintain the trout fishery (see Sections 2.2.2 and 3.2.2 of the EA). Some of the proposed operational changes in Section 3.2.2 are designed specifically, in cooperation with the TWRA, to

assure that the changes in operation would have at most minimal effects on the trout fishery. In addition, stabilization of flows from May to October would benefit trout by reducing erosion and in-stream bedload movement.

**Comment:** Is this decision reversible? (David Perry) [Similar Comments: Rhonda Page]

**TVA Response:** The USFWS issued a Biological Opinion (BO) under Section 7 of the ESA in the course of TVA's development of the River Operations Study (ROS). The BO requires TVA to improve habitat conditions for the endangered native fish and mussel species in the Elk River below Tims Ford Dam. The action alternative under this EA seeks to achieve this goal. Since the action alternative is an adaptive management alternative, some details of how the flow and temperature changes are implemented can be changed by TVA as knowledge of effectiveness is acquired. But TVA is required to make the changes to benefit the endangered species to the extent feasible while balancing the other purposes of Tims Ford Dam such as recreation, flood control, water supply, and power generation.

**Comment:** I am opposed to the current proposal to warm releases from Tim's ford Dam that would be detrimental to the trout fishery in the Elk river below the Dam. (James Flanagan) [Similar comments by Charles Baldwin, Bob Roselli, James Woldarz, Rachel Hillis, Ryan Stern, Joe S. Lay, Matthew Mullins, James A. Hendricks]

**TVA Response:** Comment noted. TVA believes the trout fishery could be maintained while achieving the primary objective of improving threatened and endangered species habitat. However, monitoring temperatures would indicate how far downstream the habitat for trout would reach. TVA believes the trout fishery habitat would be improved because of more stable flows and temperatures.

**Comment:** I am a 78-year-old man who trout fishes in the western United States in the summers and in the Elk River below Tims Ford Dam from October through May. I would prefer the No Action Alternative if possible, and if not, I want TVA to do whatever is necessary to keep the trout reach healthy for as far downstream as possible, year-round. (Robert F. Shanks Sr.)

**TVA Response:** Comment noted. TVA believes the trout fishery could be maintained with the primary objective for improving threatened and endangered species habitat; however, monitoring temperatures would indicate how far downstream the habitat would reach. TVA believes the trout fishery habitat would be improved.

**Comment:** I am writing as an avid fisherman of Tennessee's tailwaters on behalf of the Elk River fishery. It has been one of the hidden gems of the TVA regulated tailwaters, one that I would hate to see go away. According to the report that I just read we will lose a very important stretch of the river as early as this summer. I ask the TVA to please reconsider this move as a hasty knee-jerk type reaction to an environmental report. Please give the fishing community a chance to be heard. There are many of us that hold the Elk River very close to our hearts. The stretch of river from Farris Creek bridge to old Dam Ford road is already too warm for trout, and this is a very important piece of water for the fishery. Thank you for your time, and please consider my request for a delay in the warming of the river. At least give the public a chance to comment. (Chad Hayes) [Similar comments: Rachel Hillis,

Brent Moseng, Becky Croft, C.J. Sabia, Jim Whoric, James A. Hendricks, Gary P Kelley, Brent and Craig Cummings]

**TVA Response:** Comment noted. TVA believes the trout fishery could be maintained while achieving the primary objective of improving threatened and endangered species habitat; however, monitoring temperatures would indicate how far downstream the habitat for trout would reach. TVA believes the trout fishery habitat would be improved because of more stable flows and temperatures.

**Comment:** Since most of us purchase our \$80+ TN “Out of State” licenses exclusively to fish on the Elk we are wondering if the state plans on refunding a portion of that money to us given that you are deliberately destroying the one fishery that we utilize in your fair state? (Ralph Shuey)

**TVA Response:** Comment noted. TVA believes the trout fishery could be maintained with the primary objective for improving threatened and endangered species habitat; however, monitoring temperatures would indicate how far downstream the habitat would reach. TVA believes the trout fishery habitat would be improved because of more stable flows and temperatures.

**Comment:** Thank you for speaking with me regarding the Elk River fishing issues. I faxed the map to you. Please let me know if it did not come through well and I can mail a copy to you. Can you please clarify what parameters exist to determine if a protected species is in danger of becoming extinct? Specifically, the species at the center of the Elk River habitat. Don't these species already exist in the river under current water/temp conditions? Thanks in advance for your reply. (Rhonda Page)

**TVA Response:** Under the ESA, the USFWS designates a species as endangered when it is in danger of extinction throughout all or a significant portion of its range. Likewise, a “threatened” designation indicates that the species is likely to become an endangered species within the foreseeable future. Since the boulder darter is presently known to occur only in the Elk River, there is the likelihood that the species could become extinct unless these trends were reversed. A comparison of previous collected records with recent collections of mussels in the Elk River indicate that most of the protected species were previously known from the reach of the Elk River between Tims Ford Dam and Fayetteville, but none of them are now found there. The species are all presently existing in the Elk River downstream of Fayetteville, but they are apparently not reproducing or expanding their ranges.

**Comment:** While the TWRA will not officially report that there is a stream borne population of trout in the river, I know for a fact (I have personally seen the reds) in Bean creek there is natural reproduction. That is only one mile above Old Dam Ford. Your plan for water temperature will effectively end that natural reproduction. One of the main mandates for the dam originally was for recreation. How does killing trout support recreation? (Tim Page) [Similar comments: Dennis Sigman, Dane Honhart, Tim Pate]

**TVA Response:** Because this is a multi-purpose project, intended to provide water supply, recreation, flood control, and power generation, TVA desires to make changes that benefit endangered species while still achieving the other objectives of the Tims Ford project. TVA believes the trout fishery could be maintained while achieving the primary objective of improving threatened and endangered species

habitat, however, monitoring temperatures would indicate how far downstream the habitat for trout would reach. TVA believes the trout fishery habitat would be improved because of more stable flows and temperatures.

**Comment:** How will this warm water aid the production of electricity? Having had the opportunity to work for TVA a brief period of time, I now realize just how irresponsible government management is in terms of wildlife and stream management. Has TVA considered that these species of wildlife will disappear anyway due to the establishment of didimo especially last year due to minimal water release? (Dennis Sigman)

**TVA Response:** Didymosphenia geminata (Didymo) is present in the Tennessee Valley. It is a type of single-celled algae called diatoms. Programs exist within TVA to monitor fish and benthic communities, and should help document any possible impacts from Didymo.

**Comment:** I am writing to express my concerns regarding the mandate to raise water temperatures on the Elk River. As a long time fly fisher and member of Trout Unlimited, I think this is a bad idea from an environmental standpoint. The result of effectively ending the Elk River as a trout fishery would have a significant negative effect on the watershed. Here's how. I live in Murfreesboro and hike and fish most of the rivers within the southeast. I always take garbage bags with me to "clean up after others" On the Stones River garbage is deplorable along the banks. (warm water seasonal trout stream) On the Duck River garbage is bad along the banks (warm water seasonal trout stream) The Caney Fork garbage is picked up and has little or no environmental impact The Elk River garbage is picked up (additionally with a clean up day from Middle Tennessee Fly Fishers). The point is keeping the Elk as a year round trout fishery has an indirect positive impact that will end with the trout and those who fish them. I hope the decision to warm the river is reconsidered. (Mark Joines)

**TVA Response:** TVA believes the trout fishery could be maintained while achieving the primary objective of improving threatened and endangered species habitat, however, monitoring temperatures would indicate how far downstream the habitat for trout would reach. TVA believes the trout fishery habitat would be improved because of more stable flows and temperatures.

**Comment:** I want to revise my previous comments on the subject matter sent to you in my previous email. I apologize for reacting to some information provided to me without first reading the draft EA. I have now read it and to me it makes sense and has sound scientific backing and has given the trout fishery due consideration. I now support the proposed modifications and monitoring plans that should provide a continuation of the year round trout fishery while providing the subject endangered species an opportunity to reestablish a healthy population. It will certainly mean some changes for the trout fishermen but should be the best in the long run. (Jim Whoric)

**TVA Response:** Comment noted.

**Comment:** Since you have not replied to my last letter I am letting you know that we are setting up with Nashville TV stations to air video of lots and lots of trout floating on the Elk River. When it reaches its peak is when it will be taped and aired. Please don't force us to do this but we have the resources to do so. Headlines could be

TVA kills Elk River

TVA shows ignorance and lack of study in wretched decision.

TVA tries to be environmentalists and ignores warnings sent to [tmtomaszewski@tva.gov](mailto:tmtomaszewski@tva.gov).  
(Tim Pate)

**TVA Response:** TVA collects comments received during comment periods and provides a response in the final EA. Several attempts have been made by TVA to contact this person. TVA believes the trout fishery could be maintained with the primary objective for improving threatened and endangered species habitat. TVA believes the trout fishery habitat would be improved because of more stable flows and temperatures.

**Comment:** i have just learned about the new ideas on the water temp on this river below Tims Ford Dam. i really love fishing this river for Trout. i fish it anywhere from 10-15 times a yr. and hope to fish it more this yr time allowing. but i do understand trying to protect some Native endangered species that are in the river. but i do hate to see such a fine trout fishing place lost. how can i find more info on what the TVA has plan for the native fish and the trout in this river.

**TVA Response:** TVA believes the trout fishery can be maintained while achieving the primary objective of improving threatened and endangered species habitat, however, monitoring temperatures would indicate how far downstream the habitat for trout would reach. TVA believes the trout fishery habitat would be improved because of more stable flows and temperatures.

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## **Appendix C - Monitoring Plan (June 2008 Rev 0)**

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## Appendix C - Monitoring Plan (June 2008 Rev 0)

### Tims Ford Reservoir Monitoring

Monthly water quality surveys will be conducted April through October on Tims Ford Reservoir at ERM 135.0 and ERM 150.0. All sampling will be conducted over the original river channel at maximum depth. At each sampling location, water column profiles are taken for temperature, DO, pH, and conductivity. Composite samples of water within the photic zone will be collected for determination of chlorophyll, total suspended solids, total organic carbon, and various nutrients (total phosphorus, total ammonia as nitrogen, nitrate-nitrite nitrogen, and organic nitrogen).

### Tims Ford Dam Grab Sampling and Reporting Activities

From April 15 through December 21, water quality will be monitored in the scrollcase, taildeck, and tailrace of the dam. Samples will be taken and field measurements made in accordance with *Standard Methods for the Examination of Water and Wastewater*, latest edition. DO and temperature will be measured weekly from the scrollcase. DO and temperature will be measured weekly using hand-held instrumentation from the taildeck of each unit. Finally, DO and temperature grab samples will be collected downstream of the sluice gate discharge, or spillway discharge if the spillway is in use.

### Elk River Water & Habitat Quality Monitoring

#### Water Quality Monitoring

TVA biologists will evaluate effectiveness of the operational changes on water quality in the Elk River between Tims Ford Dam and ERM 30.3. This will be accomplished by completing the following actions:

- Collecting continuous water temperatures at seven locations between Tims Ford Dam and ERM 30.3 (Figure C-1).
- Survey in the upper portion of the tailwater to verify use of TVA's flow modeling for the Fayetteville Stream gage with field-collected data.
- Collecting dam and spillway release temperatures.
- Collecting quarterly water temperatures at seven stations (Figure C-1).
- Collecting sediment grab samples annually at seven stations (Figure C-1).
- Compiling data to be included in consolidated annual reports to USFWS.

### Temperature

Temperature will be analyzed in the field using a Hydrolab 5XLDO DataSonde. All Hydrolabs used are factory serviced and calibrated on an annual basis and standardized each day prior to and after use.

### Dissolved Oxygen

DO will be analyzed in the field using a Hydrolab 5XLDO DataSonde. All Hydrolabs used are factory serviced and calibrated on an annual basis and standardized each day prior to and after use. The Hydrolab 5XLDO DataSonde uses the HACH LDO Method 10360 (Luminescence Dissolved Oxygen) for the measurement of DO. On January 3, 2006, the EPA approved ASTM Standard D888-05, which includes the LDO method.

### Chlorine

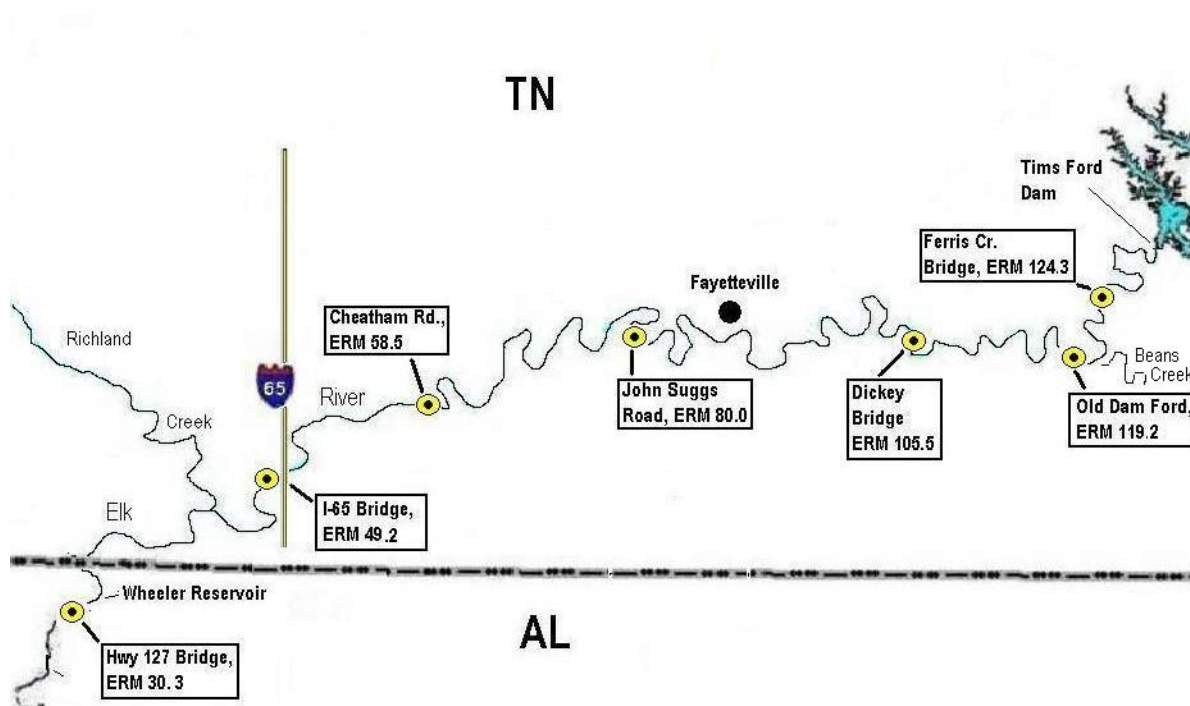
Chlorine will be analyzed in the field using a HACH Pocket Colorimeter II. HACH method 8021 (Free) and HACH 8167 (Total) are a DPD Method, adapted from *Standard Methods of the Examination of Water and Wastewater*. This method is equivalent to USEAP Method 330.5 for wastewater and Standard Method 4500-Cl G for drinking water.

### Turbidity

Turbidity can either analyzed in the field using a HACH DR850 with Method 8237 or can be sampled and submitted to Environmental Science Corp for analysis. If sampled, the sample will be collected following procedures outlined in *Standard Methods of the Examination of Water and Wastewater*

### Metals (copper, zinc, manganese, aluminum, and arsenic) and ammonia

Metals will be analyzed by Environmental Science Corporation. A sample will be collected following procedures outlined in *Standard Methods of the Examination of Water and Wastewater*.

**Figure C-1. Tims Ford Tailwater Monitoring Stations, 2008****Tims Ford Tailwater Temperature Monitoring Stations, 2008.**

### Habitat Monitoring

TVA biologists will evaluate effectiveness of the operational changes on habitat quality in the Elk River between Tims Ford Dam and RM 30.3. This will be accomplished by completing the following actions:

- Collecting flow, wetted perimeter, sedimentation, and dissolved oxygen at seven permanently established locations between Tims Ford Dam and ERM 30.3 (Figure C-1).
- Field reconnaissance to document occurrence of appropriate boulder darter and mussel habitat in the upper portion of the tailwater.
- Compiling data to be included in consolidated annual reports to USFWS.

### “Riffle” Pebble Count

The composition of the stream bed (substrate) is an important factor in how streams behave and in the quality of mussel habitat. A pebble count provides a quantitative description of the bed material. The “riffle” pebble count is a version of the Wolman pebble count (Leopold, L.B., et al. 1964) modified by Alabama Department of Environmental Quality to measure the percent fines throughout the wetted channel. The riffle pebble count is conducted in “riffle” or run habitats located within either a 2-meander long stream segment or minimum reach size of 100 meters. The data collected is used to determine the percentage of fine sediment in the substrate. The “riffle” pebble count consists of measuring particles at equal increments across multiple straight transects within the wetted width of “riffle” habitats to achieve an approximate 100 count of particles. The b axis (intermediate axis) is measured and recorded for 100 rocks. Rocks (particles) are tallied by using the pebble count size classes given in Table C-1 below and then plotted by size class and frequency. Particle size classes range from silt and clay to sand, gravel, cobbles, and boulders.

**Table C-1. Particle Size Classes Used in the Wolman Pebble Count**

| <b>Size Class</b>  | <b>Size Range (mm)</b> |
|--------------------|------------------------|
| Silt / Clay        | <0.062                 |
| Sand               | 0.063 – 2              |
| Very Fine Gravel   | 3-4                    |
| Fine Gravel        | 5-8                    |
| Medium Gravel      | 9-16                   |
| Coarse Gravel      | 17-32                  |
| Very Coarse Gravel | 33-64                  |
| Small Cobble       | 65-96                  |
| Medium Cobble      | 97-128                 |
| Large Cobble       | 129-180                |
| Very Large Cobble  | 181-256                |
| Small Boulder      | 257-512                |
| Medium Boulder     | 513-1024               |
| Large Boulder      | 1025-2048              |
| Very Large Boulder | 2049-4096              |
| Bedrock            | >4097                  |

The following instructions are provided by Potyondy, J. P., et al. 1994.

1. A stream segment of 2 meander length width is first established and marked with flagging tape. Usually three “riffles” or runs are selected within the stream segment for the pebble count. Pebbles are collected for measurement along transects within each habitat, working from the most downstream transect to the most upstream transect.
2. A tape is set up with bank pins across each transect. If three habitats are worked, divide the stream width by 33 to obtain the increment needed to collect 33 particles per transect. Do not collect particles closer than 0.3 tenths of a foot apart. If 33 particles cannot be collected per transect, make a second or third pass as close as possible to the transect tape, and working in an upstream direction without collecting pebbles from the same area worked in the first pass.
3. Use a marker system to ensure collection of a randomly selected particle. The tip of the pebble count ruler or off the front of a boot, placed at the appropriate station along the transect tape. To take particle readings, reach over the toe of the boot or at the tip of the ruler. Extend the forefinger, and without looking down, pick up the first pebble touched, and measure the intermediate axis (B) in millimeters. The intermediate axis is neither the longest nor shortest of the three mutually perpendicular sides.

A = Longest Axis (length)

B = Intermediate Axis (width)

Thickness = Shortest Axis

Determine the Size Range from the SEM Field Data Sheet (see attached field form) and record the tally. Embedded rocks are measured in place by measuring the smaller of the two exposed axes. Caution - there is a tendency to look down and select a pebble, but this should be avoided or the results will be biased toward larger particle sizes. AB Narrative Bottom Deposits Standard Implementation Procedures Revised 6/8/2007 12.

4. Discard the measured pebble downstream, move to the next station, and repeat step.
5. Continue working across the transect from wetted edge to wetted edge of the streambed. After completing the first 33 measurements at this transect, move upstream to the next transect, and repeat the process. One hundred counts is the ideal number for this procedure. The whole transect should be completed, rather than stopping data collection in mid-transect when 100 count is obtained. Sample counts are allowed to vary  $\pm 10$  counts (90-110 particles).
6. Sum the counts before leaving the stream, to ensure that the goal of  $100 \pm 10$  pebbles have been counted. If the count is within a count of 10, it is an acceptable pebble count.

**References:**

- Harrelson, C.C., C.L. Rawlins, and J.P. Potyondy. 1994. Stream channel reference sites: an illustrated guide to field technique. USDA, Forest Service, Rocky Mountain Forest and Range Experiment Station, General Technical Report RM-245. Fort Collins, Colorado.
- Leopold, L.B., M.G. Wolman, and J.P. Miller. 1964. Fluvial processes in geomorphology. Freeman, San Francisco, California.

## Elk River Biological Monitoring

### Mussell Surveys

- Mussels will be surveyed at five sites in the Elk River (Table C-2, Figure C-2) in September. Mussels will be sampled qualitatively and quantitatively by snorkeling and fanning substrate, looking for mussels that were partially exposed or buried.

**Table C-2. Localities of Five Fixed Station Elk River Mussel Monitoring Sites**

| Site           | Elk River Mile | Live Mussel Species Known from Site |
|----------------|----------------|-------------------------------------|
| Dickey Bridge  | 105.0          | 1                                   |
| Chennault Ford | 97.0           | 7                                   |
| Harms Mill     | 75.7           | 20                                  |
| I-65 Bridge    | 49.3           | 14                                  |
| Veto Bridge    | 34.5           | 17                                  |

### Mussel Monitoring Procedure Downstream of Tims Ford Dam.

Freshwater mussels will be sampled both qualitatively and quantitatively in September by snorkeling and fanning substrate, looking for mussels that were partially exposed or buried. Digging and fanning the substrate is important for finding juvenile mussels as evidence of recent reproduction and recruitment. Two sites are accessible by vehicle while the remaining three will be accessed by boat.

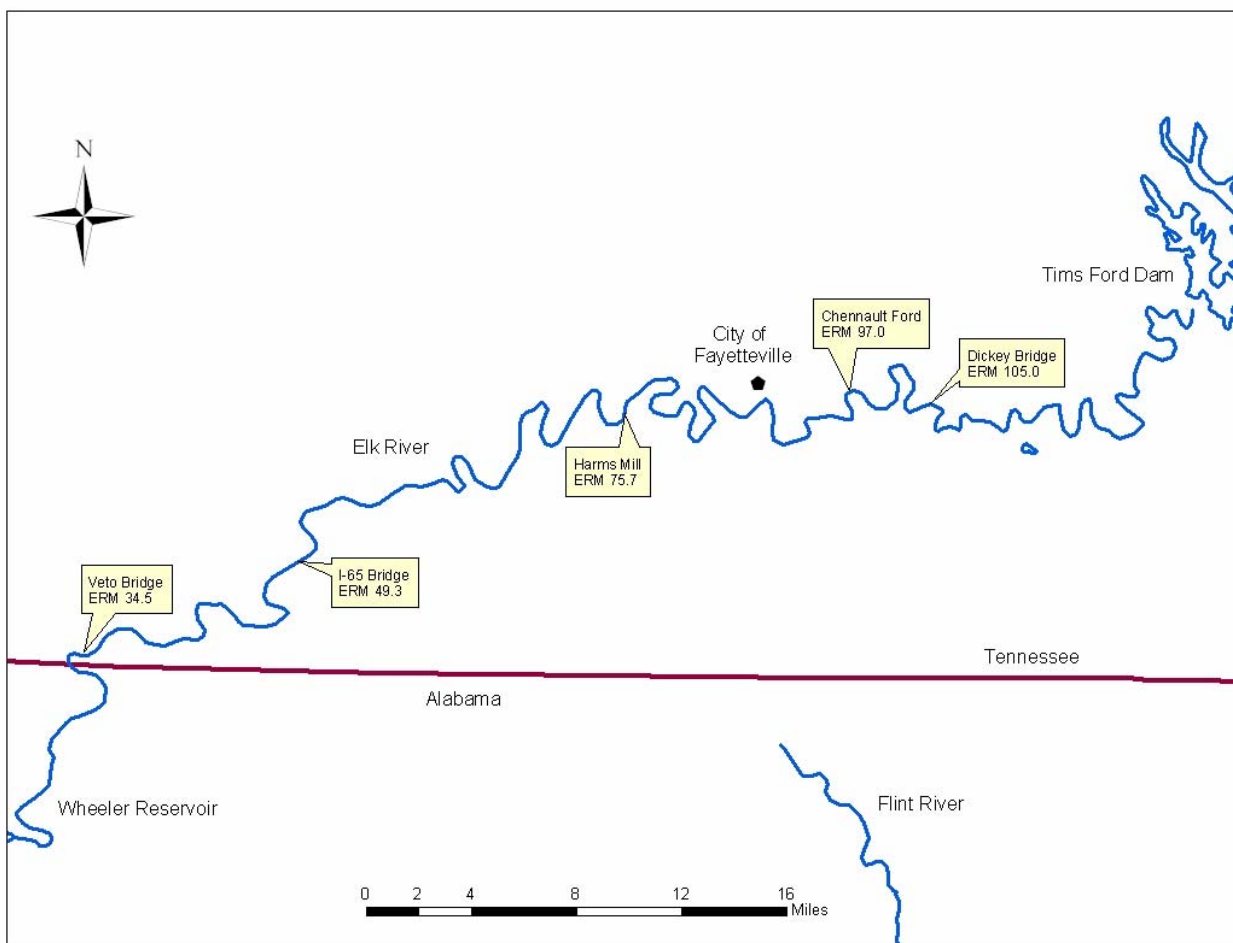
Sampling site localities were identified by latitude and longitude to degree-minutes using hand held Global Position System (GPS) unit (Garmin 60CS) and also were identified by river mile location, natural landmarks, creeks, towns, and bridge crossings, using US Geological Survey, 7.5 minute topographic maps. Qualitative sampling will consist of timed random searches of 30-minute duration (total time per site 270 minutes) for determining catch per unit effort (CPUE) (species richness and mussel densities). This technique is effective for finding rare or uncommon mussel species that may not be found in quantitative sampling and offers greater sampling (spatial coverage) in habitats not sampled quantitatively.

Quantitative sampling will consist of placing a 0.25m<sup>2</sup> metal framed quadrat sampler on top of the substrate to be excavated for mussels. Marked cables will be stretched out along left and right banks in a 30x50 m grid for sampling and quadrat locations in the river were selected using a table of random numbers. Substrate within the quadrat will be searched for mussels to a depth of 4-6 inches. All mussels found within the confines of the sampler will be recorded by location within the grid, identified to species, measured, and recorded on field data. If this method of determining random sampling sites is not applicable at a certain location, a suitable similar method of random stratified sampling will be performed.

A total of 40 quadrat samples will be hand excavated at each sampling site, including four quadrat samples located closest to the left bank (waters edge) and four along the right bank. Substrate excavated from the four left/right bank quadrats will be collected in D-nets and placed in large trays for sorting. Substrate will be carefully sifted looking for smaller

size-class juvenile mussels (evidence of recent recruitment). All live and fresh dead mussels (evidence of meat inside of shell, shiny nacre) will be recorded on field data sheets and measured in millimeters (total length anterior-posterior) using a dial caliper. Photographs were taken of some selected mussel species and all live mussels found during sampling will be hand placed back into the substrate. The number of relict mussel species found will be recorded by site, including the presence of live pleurocerid riversnails..

**Figure C-2. Five Fixed-Station Monitoring Sites on the Elk River, Tennessee.**



### **Boulder Darter Monitoring**

- Surveys for presence of boulder darters or appropriate boulder darter habitat will occur at ERM 97.0, 119.2, and one additional site in the downstream portion of the river (exact locality to be determined) in late summer or early fall.



### Boulder Darter Survey Procedures

Quantitative Sampling: 100 ft<sup>2</sup> samples (10 ft X 10 ft) will be taken by kicking into a 10-foot net set immediately downstream of areas of identified suitable habitat. Up to 40 samples will be taken at each location depending upon available habitat. Catch per unit effort (CPUE) will be calculated at each site.

Qualitative Sampling: Where water flow and water clarity are suitable, biologists will snorkel along transects and collect boulder darters in likely habitats. All boulder darters will be measured in the field and released back into their appropriate habitat after measurements have been taken. This technique is effective for finding individual boulder darters that may not be found in quantitative sampling and offers greater sampling (spatial coverage) in habitats not sampled quantitatively.

### Data Summarization and Analysis

Boulder darter abundance, density, and frequency of occurrence will be calculated as catch per unit effort. Length frequency data will be used to indicate approximate age class distribution.